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Europäisches Patentamt
European Patent Office
Office européen des brevets

⑪ Publication number:

0 227 884
A2

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EUROPEAN PATENT APPLICATION

⑲ Application number: **86109620.4**

⑮ Int. Cl.: **C 05 B 7/00, C 05 B 13/00**

⑳ Date of filing: **14.07.86**

③ Priority: **27.11.85 IT 8415785**

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④ Date of publication of application: **06.07.87**
Bulletin 87/28

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⑧ Designated Contracting States: **AT BE CH DE FR GB IT LI
LU NL SE**

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⑤ **Process for producing liquid fertilisers in high-concentration solution, and the fertilisers obtainable by the process.**

⑥ The process for producing liquid fertilisers in high-concentration solution, is characterised by reacting, under temperature and pH control, thermic polyphosphoric acid with potassium hydroxide solution, to obtain a potassium polyphosphate solution which reacts with ammonium polyphosphate to give a ternary solution of ammonia nitrogen, phosphoric anhydride in ortho and polyphosphatic form, and potassium hydroxide, water being added in the quantity required by the fertiliser composition to be obtained.

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This invention relates to a process for producing liquid fertilisers in high-concentration solution, and the fertilisers obtainable by the process.

Fertilisers are known consisting of a ternary solution of nitrogen, phosphorus and potassium in various percentages. They are generally distributed over the soil by conventional distributing machines such as pumps fitted with a sprayer bar, and enable fertilising, deweeding, geodisinfestation and/or other antiparasitic treatments to be carried out in a single passage with controlled and predetermined uniform distribution. However, a serious drawback of known liquid fertilisers is the rather low limit to their obtainable maximum concentration (about 25%).

Although this generally represents a somewhat serious problem in that it results in high storage and handling costs for volumes which become greater the quantity of fertiliser to be distributed, it represents an even more serious problem where the fertiliser is to be distributed by helicopter, because of the greater costs involved in this distribution system.

It is possible to increase the fertiliser concentration by using suspensions instead of solutions. In this manner it is possible to reach concentration values of

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50-60%, but with other considerable limitations, in that:

- special equipment other than pumps with a sprayer bar has to be used for their distribution,
- special tanks provided with a mixer, which inter alia results in energy consumption, have to be used for their storage,
- the suspensions have to be used within a very short time (3 or 4 days at the most) from their preparation,
- pollution is caused because of the loss of about 50% of the distributed product by lixiviation and solid formation by the soil,
- the fertiliser cannot be mixed with the herbicide and insecticide (these having to be distributed with subsequent passages), and their distribution becomes non-uniform and uncontrollable.

In addition known ternary fertilisers, whether in solution or suspension form, contain potassium in the form of chloride or sulphate, and this represents a serious drawback in that chlorine and sulphur are poisonous to crops.

The object of the invention is to produce fertilisers having the merits of known fertilisers both in solution and in suspension form, but which at the same time

obviate their drawbacks.

This object is attained according to the invention by a process for producing liquid fertilisers in high-concentration solution, characterised by reacting, 5 under temperature and pH control, thermic polyphosphoric acid with potassium hydroxide solution, to obtain a potassium polyphosphate solution which reacts with ammonium polyphosphate to give a ternary solution of ammonia nitrogen phosphoric anhydride in ortho and polyphosphatic form, and 10 potassium hydroxide, water being added in the quantity required by the fertiliser composition to be obtained.

According to the invention, the aforesaid reactions can be conducted in a vessel in which a thermal buffer has been previously created.

15 With the process of the invention, fertilisers can be obtained consisting of an aqueous solution of ammonia nitrogen, phosphoric anhydride in ortho and polyphosphatic form, and potassium hydroxide.

A preferred embodiment of the present invention is 20 described in detail hereinafter with reference to the accompanying drawing which shows a block diagram of a plant for implementing the process according to the invention.

As shown on the drawing, to implement the process

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according to the invention a plant is used comprising three tanks 1, 2 and 3 for polyphosphoric acid, potassium hydroxide solution and ammonium polysphosphate respectively.

The polyphosphoric acid is of "thermic" type, ie
5 with a phosphoric anhydride content of between 56 and 85%.

The tanks 1, 2 and 3 are connected to a single reactor 4 by pumps 5, 5, 7 respectively, and by way of conventional shut-off and control valve assemblies 8, 9, 10.

A water feed pipe 11 also provided with
10 conventional shut-off and control valve assemblies 12 is connected to the said reactor 4. The reactor 4 is provided with a stirrer 13 and a cooling system 14 for removing the heat generated by the exothermic reaction, to thus maintain the temperature of the obtained solution within
15 predetermined limits.

One or more tanks 15 for the final product are also connected to the reactor 4.

Generally, according to the process of the invention, the raw materials ("thermic" polyphosphoric acid,
20 potassium hydroxide and ammonium polyphosphate) contained in the tanks 1, 2, 3 respectively are fed in the required quantities into the reactor 4 into which water is also fed.

Water is firstly fed into the reactor, followed by

caustic potash and acid in stoichiometric quantity, and ammonium polyphosphate. The potassium hydroxide solution reacts with the polyphosphoric acid to form an aqueous potassium polyphosphate solution comprising hydrated
5 potassium orthophosphate, hydrate potassium pyrophosphate and tripotassium phosphate. As the potassium polyphosphate solution forms, it reacts with the ammonium polyphosphate contained in the reactor 4 to form a ternary solution of ammonia nitrogen, phosphoric anhydride in ortho and
10 polyphosphatic form and potassium hydroxide, as a blend.

The reaction between the polyphosphoric acid and potassium hydroxide is strongly exothermic. However to prevent the heat of reaction decomposing the ammonium polyphosphate at high temperature and causing loss of water
15 and ammonia by evaporation, thus altering the final product concentration, the cooling system 14 is provided to keep the temperature within the reactor 4 at the required value.

Moreover, in order to prevent the formation of soluble salts in the reaction between potassium hydroxide
20 and polyphosphoric acid, a pH control system is provided to maintain the pH within the reactor 4 at between 6 and 8.

Finally, the reaction is initiated after creating within the reactor 4 a thermal buffer which can consist

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either of water itself or of a certain quantity of the final product to be obtained.

In all cases, the final product obtained is a ternary solution of nitrogen, phosphorus and potassium of high concentration (up to about 50%) which can be expressed in the form (N.P.K.), in which N, P and K are whole numbers indicating the percentage of the corresponding substances nitrogen, phosphoric anhydride and potassium hydroxide in the solution.

10 The process according to the invention described heretofore enables liquid fertilisers to be obtained which are much more advantageous than known liquid fertilisers both of the solution and of the suspension type.

 Compared with the former, the liquid fertiliser
15 obtainable by the process according to the invention can be produced in a much higher concentration (currently up to 50%), thus reducing storage, transport and distribution costs for equal amounts of fertiliser to be distributed.

 Compared with the latter, it has all the advantages
20 of a fertiliser in solution over fertilisers in suspension, and in particular:

- easy distribution,
- elimination of special storage tanks provided with

mixers,

- usability of the fertiliser even after a lengthy period following its preparation,
- the possibility of mixing the fertiliser with the herbicide and insecticide to allow a single overall treatment of the soil, with uniform and controlled distribution.

Finally, compared with both types, the fertiliser obtainable by the process according to the invention has the important advantage of containing potassium in the form of hydroxide, ie neither as chloride nor as sulphate. Consequently neither chlorine nor sulphur are fed into the soil, these representing a potential danger to crops.

The following examples will further clarify the invention.

EXAMPLE 1 - Production of fertiliser 3.21.21

The fertiliser 3.21.21 consists of a ternary solution of nitrogen, phosphorus and potassium having the following composition (by weight):

20 Nitrogen	3%
Phosphoric anhydride	21%
Potassium hydroxide	21%

The following were fed into a reactor in order to produce

it:

Water	75.8 kg
48% potassium hydroxide solution	438 kg
58% potassium polyphosphoric acid	186.2 kg
5 Ammonium polyphosphate (10.34.0)	300 kg.

As the constituents were fed in the stated order into the reactor they were mixed, the temperature being simultaneously controlled at around ambient temperature.

On termination of the reaction, 1000 kg of ternary
10 fertiliser 3.21.21 were obtained.

EXAMPLE 2 - Production of fertiliser 3.26.18

The following were fed into the reactor:

Water	69.9 kg
48% potassium hydroxide solution	375 kg
15 58% thermic polyphosphoric acid	255.1 kg
Ammonium polysphosphate (10.34.0)	300 kg

On termination of the reaction, 1000 kg of ternary
fertiliser 3.25.18 were obtained.

EXAMPLE 3 - Production of fertiliser 3.18.20

20 The following were fed into the reactor:

Water	149.5 kg
48% potassium hydroxide solution	416 kg
58% thermic polyphosphoric acid	134.5 kg

Ammonium polyphosphate (10.34.0) 300 kg

On termination of the reaction, 1000 kg of ternary
fertiliser 3.18.20 were obtained.

EXAMPLE 4 - Production of fertiliser 0.13.17

5 The following were fed into the reactor:

Water 420 kg

48% potassium hydroxide solution 355 kg

58% polyphosphoric acid 225 kg.

On termination of the reaction, 1000 kg of binary fertiliser
10 0.13.17 were obtained.

C L A I M S

1. A process for producing liquid fertilisers in high-concentration solution, characterised by reacting, under temperature and pH control, thermic polyphosphoric acid with potassium hydroxide solution, to obtain a potassium polyphosphate solution which reacts with ammonium polyphosphate to give a ternary solution of ammonia nitrogen, phosphoric anhydride in ortho and polyphosphatic form, and potassium hydroxide, water being added in the quantity required by the fertiliser composition to be obtained.
2. A process as claimed in claim 1, characterised in that the reactions are conducted in a reactor, in which a thermal buffer has been previously created.
3. A process as claimed in claim 2, characterised by creating a thermal buffer in the reactor by means of water.
4. A process as claimed in claim 2, characterised by creating a thermal buffer in the reactor by means of a predetermined quantity of the final product to be obtained.
5. A process as claimed in claim 1, characterised by feeding water, potassium hydroxide solution, thermic polyphosphoric acid and ammonium polyphosphate into the reactor in the stated order under stirring.

6. A process as claimed in claim 1, characterised by maintaining the pH at between 6 and 8.
7. A liquid fertiliser in high-concentration solution obtainable by the process claimed in one or more of claims 1 to 6, characterised by consisting of an aqueous solution of ammonia nitrogen, phosphoric anhydride in ortho and polyphosphatic form, and potassium hydroxide.
8. A fertiliser as claimed in claim 7, characterised by being of the 3.21.21. type, in which the first number expresses the percentage of ammonia nitrogen in the solution, the second number expresses the percentage of phosphorus in the form of phosphoric anhydride in ortho and polyphosphatic form, and the third number expresses the percentage of potassium in the form of potassium hydroxide.
9. A fertiliser as claimed in claims 7 and 8, characterised by being of the 3.25.18. type where the indicated values have the aforesaid meaning.
10. A fertiliser as claimed in claims 7 and 8, characterised by being of the 3.18.20. type where the indicated values have the aforesaid meaning.
11. A fertiliser as claimed in claims 7 and 8, characterised by being of the 0.13.17. type where the indicated values have the aforesaid meaning.

